HW2

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Load in Data

```
d = read.table("T4-6.DAT")
```

Mardia Multivariate Normality Test

```
mvn(d, mvnTest = 'mardia')
```

```
## $multivariateNormality
##              Test         Statistic             p value Result
## 1 Mardia Skewness  66.3397814411797   0.922097864063478    YES
## 2 Mardia Kurtosis -2.66574035625517 0.00768189967020949     NO
## 3             MVN              <NA>                <NA>     NO
##
## $univariateNormality
##           Test  Variable Statistic   p value Normality
## 1 Shapiro-Wilk    V1        0.9749  0.0162      NO
## 2 Shapiro-Wilk    V2        0.9779   0.032      NO
## 3 Shapiro-Wilk    V3        0.9839  0.1269      YES
## 4 Shapiro-Wilk    V4        0.9846   0.15       YES
## 5 Shapiro-Wilk    V5        0.9626  0.0012      NO
## 6 Shapiro-Wilk    V6        0.6356  <0.001      NO
## 7 Shapiro-Wilk    V7        0.6322  <0.001      NO
##
## $Descriptives
##      n      Mean   Std.Dev Median Min Max  25th 75th        Skew   Kurtosis
## V1 130 15.669231 5.8949308     15   3  31 11.25   19  0.42717915 -0.3713156
## V2 130 17.076923 4.1849034     18   6  27 14.00   20 -0.30997420 -0.4291609
## V3 130 18.784615 5.4630324     19   2  29 15.00   22 -0.29888485 -0.2146062
## V4 130 15.500000 5.7482724     16   1  27 11.25   19 -0.16098365 -0.6276702
## V5 130 11.730769 5.1921056     11   2  29  8.00   15  0.66929028  0.1241775
## V6 130  1.523077 0.5013994      2   1   2  1.00    2 -0.09134199 -2.0069174
## V7 130  1.446154 0.4990151      1   1   2  1.00    2  0.21414963 -1.9691099
```

Henze-Zirkler MVN test

```
mvn(d,mvnTest='hz')
```

```
## $multivariateNormality
```

```
##            Test       HZ      p value MVN
## 1 Henze-Zirkler 1.262776 1.110223e-16  NO
##
## $univariateNormality
##           Test  Variable Statistic   p value Normality
## 1 Shapiro-Wilk    V1        0.9749  0.0162      NO
## 2 Shapiro-Wilk    V2        0.9779   0.032      NO
## 3 Shapiro-Wilk    V3        0.9839  0.1269      YES
## 4 Shapiro-Wilk    V4        0.9846   0.15       YES
## 5 Shapiro-Wilk    V5        0.9626  0.0012      NO
## 6 Shapiro-Wilk    V6        0.6356  <0.001      NO
## 7 Shapiro-Wilk    V7        0.6322  <0.001      NO
##
## $Descriptives
##      n      Mean   Std.Dev Median Min Max  25th 75th        Skew   Kurtosis
## V1 130 15.669231 5.8949308     15   3  31 11.25   19  0.42717915 -0.3713156
## V2 130 17.076923 4.1849034     18   6  27 14.00   20 -0.30997420 -0.4291609
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## V4 130 15.500000 5.7482724     16   1  27 11.25   19 -0.16098365 -0.6276702
## V5 130 11.730769 5.1921056     11   2  29  8.00   15  0.66929028  0.1241775
## V6 130  1.523077 0.5013994      2   1   2  1.00    2 -0.09134199 -2.0069174
## V7 130  1.446154 0.4990151      1   1   2  1.00    2  0.21414963 -1.9691099
```

Royston MVN test

```
mvn(d, mvnTest = 'royston')
```

```
## $multivariateNormality
##      Test        H      p value MVN
## 1 Royston 151.7001 9.065643e-30  NO
##
## $univariateNormality
##           Test  Variable Statistic   p value Normality
## 1 Shapiro-Wilk    V1        0.9749  0.0162      NO
## 2 Shapiro-Wilk    V2        0.9779   0.032      NO
## 3 Shapiro-Wilk    V3        0.9839  0.1269      YES
## 4 Shapiro-Wilk    V4        0.9846   0.15       YES
## 5 Shapiro-Wilk    V5        0.9626  0.0012      NO
## 6 Shapiro-Wilk    V6        0.6356  <0.001      NO
## 7 Shapiro-Wilk    V7        0.6322  <0.001      NO
##
## $Descriptives
##      n      Mean   Std.Dev Median Min Max  25th 75th        Skew   Kurtosis
## V1 130 15.669231 5.8949308     15   3  31 11.25   19  0.42717915 -0.3713156
## V2 130 17.076923 4.1849034     18   6  27 14.00   20 -0.30997420 -0.4291609
## V3 130 18.784615 5.4630324     19   2  29 15.00   22 -0.29888485 -0.2146062
## V4 130 15.500000 5.7482724     16   1  27 11.25   19 -0.16098365 -0.6276702
## V5 130 11.730769 5.1921056     11   2  29  8.00   15  0.66929028  0.1241775
## V6 130  1.523077 0.5013994      2   1   2  1.00    2 -0.09134199 -2.0069174
## V7 130  1.446154 0.4990151      1   1   2  1.00    2  0.21414963 -1.9691099
```

Cramer Von Mises UVN test

```
mvn(d, univariateTest= 'CVM')
```

```
## Warning in FUN(newX[, i], ...): p-value is smaller than 7.37e-10, cannot be
## computed more accurately

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## computed more accurately
```

```
## $multivariateNormality
##              Test         Statistic             p value Result
## 1 Mardia Skewness  66.3397814411797   0.922097864063478    YES
## 2 Mardia Kurtosis -2.66574035625517 0.00768189967020949     NO
## 3             MVN              <NA>                 <NA>     NO
##
## $univariateNormality
##               Test  Variable Statistic   p value Normality
## 1 Cramer-von Mises    V1        0.1481  0.0248      NO
## 2 Cramer-von Mises    V2        0.2235  0.0027      NO
## 3 Cramer-von Mises    V3        0.0932   0.138      YES
## 4 Cramer-von Mises    V4        0.1059  0.0923      YES
## 5 Cramer-von Mises    V5        0.2559  0.0011      NO
## 6 Cramer-von Mises    V6        3.7887  <0.001      NO
## 7 Cramer-von Mises    V7        3.8676  <0.001      NO
##
## $Descriptives
##      n      Mean   Std.Dev Median Min Max  25th 75th        Skew   Kurtosis
## V1 130 15.669231 5.8949308     15   3  31 11.25   19  0.42717915 -0.3713156
## V2 130 17.076923 4.1849034     18   6  27 14.00   20 -0.30997420 -0.4291609
## V3 130 18.784615 5.4630324     19   2  29 15.00   22 -0.29888485 -0.2146062
## V4 130 15.500000 5.7482724     16   1  27 11.25   19 -0.16098365 -0.6276702
## V5 130 11.730769 5.1921056     11   2  29  8.00   15  0.66929028  0.1241775
## V6 130  1.523077 0.5013994      2   1   2  1.00    2 -0.09134199 -2.0069174
## V7 130  1.446154 0.4990151      1   1   2  1.00    2  0.21414963 -1.9691099
```

Analysis

We cannot conclude that the data is multivariate normal, since all but the Mardia Skewness test rejected the null hypothesis. Moreover only variables V3 and V4 appear to be univariate normal. V3 and V4 were both labeled as univariate normal by the Shapiro-Wilik test and the Cramer Von Mises test, and both tests rejected the hypothesis of normality for all other vaiables.